



Periodicity in the electron fluences observed in different phases of solar cycle 22

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Abstract : Power spectrum analyses of the Fourier series constructed in different phases of the 22nd solar cycle give rise to the different values of periodicity of the electron fluences. The first harmonic of the periodicity values occurs around 11–14 days and the second harmonic in the range 22–27 days, this sort of periodic behaviour is similar to that of green-line coronal indices reported by earlier workers.

Keywords : Sun, electron fluences, periodicity

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Different types of periodicities in different kinds of solar activity in respect of their energy values were reported by the different workers from time to time [1–4]. In one of such studies [1], we reported 74-day periodicity of the proton fluences irrespective of their energy values. Ozguc and Atac [2] found periodicity of 73 days in the solar flare index, 90 days in the value of basal component of UV flux and 10.7 cm radio flux. In this paper, an attempt has been made to examine the periodicity of the electron fluences, the data of which were obtained from the various volumes of Solar Geophysical Data bulletins issued by U. S. Department of Commerce. In order to investigate whether the periodicity is influenced by the solar cycle effect, the study has been carried out in different parts of the 22nd solar cycle peaking around 1991.

Three separate time series of the electron fluence data were made at the rising phase (August 1988–July 1989), the peak phase (January–December, 1991) as well as the falling phase (January–December, 1993) of the 22nd solar cycle. These Fourier series were treated separately for determining the Fourier coefficients by choosing various arbitrary time

periods which range from 2 to 200 days. The results are displayed in Figures 1, 2 and 3 respectively for the afore-mentioned periods. From all these figures, it is observed that the

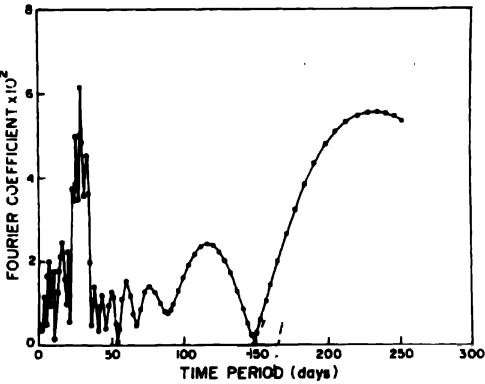


Figure 1. Power spectral curve showing the variation of Fourier coefficients against the time period in days for the period August, 1988–July, 1989. The primary peak occurs around 24 days and the secondary peak around 14 days.

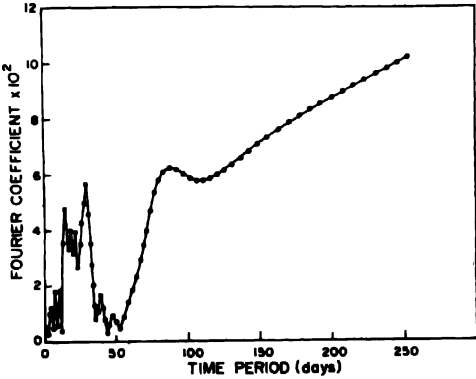


Figure 2. Power spectrum for the period January–December, 1991 with two prominent peaks around 27 and 12 days.

primary peaks occur around 24, 27 and 22 days and the secondary peaks around 14, 12 and 14 days in the rising, peak and falling phases of the 22nd solar cycle respectively.

In order to examine whether the periodicity is influenced by the sunspot activity, correlation study between the electron fluence and the sunspot number was made, but the correlation coefficient between the two variables was found to be very low of the order of 10–15%.

From the above analysis, it appears that the periodicity of the electron fluences varies in the range 22–27 days which correspond to the primary peaks and 11–14 days in

case of secondary peaks. If the lower period be designated as the first harmonic, then the higher period becomes the second harmonic, as this range is nearly double that of the first.

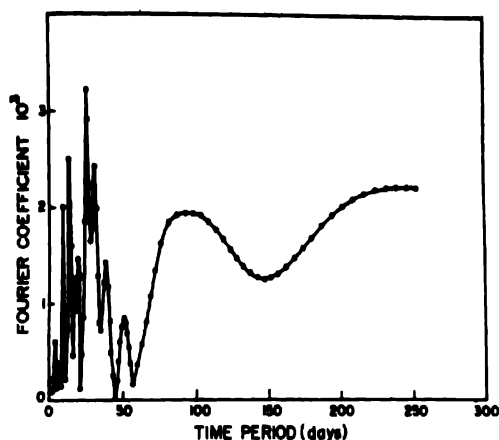


Figure 3. Power spectrum for the period January–December, 1993 with two prominent peaks around 22 and 14 days

Again, as the correlation between the sunspot number and the electron fluences has been examined to be very low, it may be concluded that the periodicity found out for the electron fluences is not guided by the sunspot activity. The averaged synodic rotational rate of the corona, as derived from the green-line coronal index which seems to be the best indicator of the coronal effects of magnetic activity erupting from the photosphere, is about 27.2 days [5]. This rotation rate differs slightly for the northern and southern hemispheres and is also a function of type and lifetime of coronal structures, phase of cycle, etc. As most of the electrons are coming out of the corona, the periodicity in the electron fluences might be governed by the coronal features which is indicated by the coronal indices, having the periodicity similar to that of electron fluences.

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